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Hawaiian Pseudococcidae (Hemiptera): A Group That Perkins Missed[1]

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ABSTRACT: Among the 16 or so recognized families of Coccoidea, only Pseudococcidae and the small, specialized Halimococcidae are represented in the endemic Hawaiian fauna. Why other large coccoid families failed to establish there is unknown. The endemic Pseudococcidae of Hawai'i currently include 31 described species in 13 genera. Ten genera are endemic. Around 40 undescribed endemic mealybug species belonging to both described and undescribed genera also are known. Perkins apparently collected no endemic mealybugs. Kirkaldy in *Fauna Hawaiiensis* listed the "Family Coccidae" (= Coccoidea) as absent from the endemic Hawaiian fauna. At least five or six, possibly more, prehistoric colonizations of Hawai'i by mealybugs were required to produce the existing fauna. Most of the endemic genera are so highly specialized that their relationships to extra-Hawaiian forms are obscure. However, some endemic species of *Pseudococcus* appear to be closely related to species in Australia and the Pacific islands. This conclusion is based primarily on similarities in male genitalia and secondarily on female morphology. Endemic Hawaiian mealybugs are often cryptic, occupying habitats such as plant galls, rolled leaves, under bark, and leaf sheaths of grasses. Those that occupy more exposed locations on foliage or twigs usually are cryptically colored or armed with large spines. These specialized habitats and morphologies appear to have evolved in response to pressure from predators.

R. C. L. PERKINS WAS AN exceptionally diligent and skillful field entomologist. The collections that he made in Hawai'i, which formed the basis for the *Fauna Hawaiiensis* series, are proof of this. Some of the species collected by Perkins and described in that work have not been recollected since, despite the collecting efforts of a fairly large number of competent entomologists.

However, Perkins did not collect representatives of every species present in Hawai'i. Like those of all entomologists, his collections tended to favor certain groups in which he was most interested: the Coleoptera, Lepidoptera, Neuroptera, and larger Hymenoptera, for example. Many of the minute parasitoid Hymenoptera, and soft-bodied groups such as Coccoidea, were not well represented in his material. Of the Coccoidea, Kirkaldy (1901, 1913), who treated the Homoptera in *Fauna Hawaiiensis,* listed the "Family Coccidae" (= Superfamily Coccoidea of modern classification), along with Aleyrodidae and Aphidae, as being absent from the endemic fauna of Hawai'i. In this he was mistaken.

Coccoidea, except for the fragile and ephemeral adult males, are sessile plant parasites. As adults they move very little or not at all. Strenuous beating of plant foliage sometimes will dislodge a few, but these are often damaged or are overlooked and discarded. Generally, collectors of Coccoidea are specialists who find their quarry through careful scrutiny of foliage, twigs, and branches and seldom collect much else. Perkins, with only a limited opportunity to collect in most areas of Hawai'i that he visited, could hardly have been expected to devote his time and energy to searching for the often cryptic Coccoidea. Apparently, he found none, or at least none were included in the collections that he made.

But they were there. Like all of the endemic biota, the Hawaiian Coccoidea are highly disharmonic. (In reference to Hawaiian biota I use the term "endemic" in the sense of Zimmerman [1948] and others, to indicate forms native to and found only in the Hawaiian Islands, having

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evolved there from prehistoric natural immigrants.) Of the 13 or so families now recognized in this superfamily, only two, the Halimococcidae (palm scales) and the Pseudococcidae (mealybugs), are represented in the endemic fauna. Halimococcidae is a small, highly specialized family, the Hawaiian species of which only occur on endemic *Pritchardia* fan palms. There are four described and several undescribed species, placed in two genera: *Colobopyga* (cosmopolitan) and *Platycoccus* (endemic) (Beardsley 1963).

The endemic Hawaiian mealybugs are much more numerous. Although they are still very incompletely known, 31 species in 13 genera have been described (Beardsley 1971). Ten of the genera are unknown outside Hawai'i and therefore are believed to be endemic. The 31 described endemic Hawaiian pseudococcids represent less than half of the existing endemic fauna in this group. I have specimens of around 40 undescribed species, and I am certain that others exist that have yet to be collected. Several of the undescribed species that I have seen cannot be placed into named genera, and new genera will be needed to accommodate these.

The endemic Hawaiian Halimococcidae appear to have been derived from two ancestral colonizations. It is unclear how many such colonizations were responsible for producing the current endemic mealybug fauna, but there must have been at least five or six, possibly more. Because phylogenetic relationships among mealybug genera are still poorly understood, and because many of the endemic Hawaiian genera are highly specialized and morphologically diverse, it is not yet possible to relate them confidently to extra-Hawaiian forms. However, in the cosmopolitan genus *Pseudococcus* Westwood, which contains numerous Hawaiian species, both described and undescribed, at least some of the Hawaiian forms are clearly allied to others that are known to occur in Australia and the Pacific islands. This conclusion was based primarily on similarities in the structure of the male genitalia and secondarily on female morphology (Beardsley 1962, unpubl. data). In Pseudococcidae, as in all of the Coccoidea, classification has been based largely on the morphology of the neotenic adult female stage. For the most part, the small, ephemeral adult males have been ignored.

Among the larger families of Coccoidea, which, in addition to the Pseudococcidae, include the Margarodidae, Coccidae, Eriococcidae, and Diaspididae, it appears that only Pseudococcidae has endemic representatives in Hawai'i. Apparently, mealybugs were able to establish themselves in prehistoric Hawai'i several times, yet the other large families of Coccoidea failed to do so. This pattern is true not only in Hawai'i, but on other isolated oceanic islands as well. Is there something inherent in the physiology and/or behavior of mealybugs that gives them a better chance of surviving overseas dispersal than species of other families of Coccoidea? I don't have an answer to this question. I speculate that migrating seabirds carrying mealybugs on their bodies may have served as vehicles for the overseas distribution of ancestral colonizing species, but this might be difficult to demonstrate.

Most of us think of mealybugs in terms of the common pest species that infest crops and ornamental plants, with massive aggregations of closely packed individuals producing copious honeydew that attracts ants and flies—a generally messy group of insects. However, the endemic Hawaiian mealybugs rarely fit that model. I have occasionally seen moderately heavy infestations of some of the less-specialized *Pseudococcus* species (e.g., *P. nudus* Ferris) on native plants in Hawai'i. More commonly, Hawaiian mealybugs are scattered, cryptic creatures, seldom apparent to the casual observer, even to most biologists. To find them you must search for them, but they are there.

Hawaiian mealybugs occupy a variety of cryptic niches. I look for them under loose bark, in rolled leaves or leaf galls, including galls abandoned by psyllid nymphs, and under leaf sheaths of native grasses and sedges. Some live on leaf surfaces, but are cryptically colored or armed with heavy spines. Obviously, they have evolved their present forms in response to pressure from predators. Many of the species are highly host specific, having been found on a single species of endemic host plant (e.g., *Clavicoccus* spp., *Phylococcus oahuensis* (Ehrhorn), *Ohiacoccus cryptus* Beardsley). Others, particularly *Pseudococcus* spp., may occur on several,

sometimes unrelated, host species, usually within a particular biome (e.g., *P. nudus* in high-elevation scrubland). Even among the more polyphagous endemic mealybug species there are no valid records of any having been taken on nonnative plants.

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